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UNH Researchers Use High-Technology Sensors to Understand Water Quality

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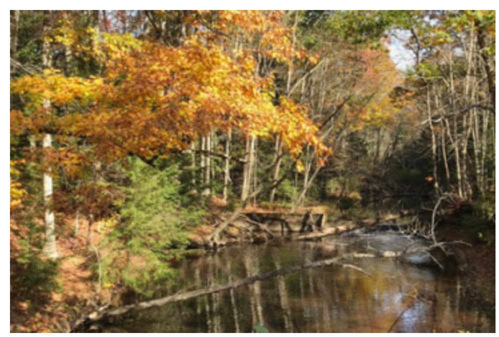
DURHAM, N.H. – Freshwater streams and rivers naturally clean up some forms of pollution originating from urban and agricultural areas, but increased storm intensity reduces this ability, which underscores the need to improve the management of nonpoint sources of pollution and storm water management, according to new research from the New Hampshire Agricultural Experiment Station at the University of New Hampshire.



NH AGRICULTURAL EXPERIMENT STATION RESEARCHERS STUDIED PART OF THE OYSTER RIVER WATERSHED SYSTEM -- THE RIVER NETWORK -- TO SEE HOW MUCH NITROGEN IT REMOVED.

The research findings advance efforts to further understand the ability of streams and rivers to clean watershed pollution and determine how to best manage nonpoint nitrogen inputs associated with human activity. Scientists used a new generation of high-technology sensors placed directly into streams and rivers to measure nitrate concentrations continuously under different flow conditions. These sensors are transforming the understanding of water quality and how to improve its management.

“Worldwide, people have doubled the amount of nitrogen entering the environment over the last century,” said Wilfred Wollheim, associate professor of natural resources and the environment. “Much of this nitrogen is not exported through rivers to coastal areas, despite the fact that many coastal areas have been greatly impaired by nitrogen. A big question remains as to where all that human-introduced nitrogen goes. This work looks at part of the Oyster River watershed system -- the river network -- to see how much can be removed by it.”

Nonpoint source pollution generally results from land runoff, atmospheric deposition, fertilizers, septic systems, and/or hydrologic modification from ever expanding road networks. Nonpoint source pollution comes from many diffuse sources such as agricultural land, construction sites, faulty septic systems, and residential areas. It is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural elements and human-made pollutants, finally depositing them into streams, rivers, lakes, wetlands, coastal waters, and ground waters.

Specifically, the researchers found:

- Urban and agricultural areas contribute much higher nutrient inputs to streams and rivers than forests, especially during storms.
- Freshwater ecosystems are able to clean some of this higher nutrient input before it gets to coastal areas.
- The ability of freshwaters to clean up nutrient pollution goes down rapidly with larger storms.
- Improvements need to be made in nonpoint nutrient management on land by reducing inputs while taking into account different storm intensity or by increased storm water management.

“The Great Bay Estuary is considered nitrogen-impaired in part due to nonpoint nitrogen sources from its watersheds. The problem would be even worse if it were not for the fact that streams and rivers clean up some of that nitrogen pollution before it gets to the bay. It is important to protect streams and rivers so they can continue to provide this important ecosystem service,” Wollheim said.

“But climate scientists predict that storminess will increase in the future, associated with climate change, which means less retention by rivers. Therefore, it becomes even more important to reduce the original nitrogen sources, which enter the watershed in fertilizer, human waste, and through atmospheric pollution. We need to think about whether we need to fertilize our lawn as much, make sure our septic systems are maintained, and support legislation to help reduce nutrient inputs, especially as more people move to the region” he said.

These research results are presented in Aquatic Nitrate Retention at River Network Scales Across Flow Conditions Determined Using Nested In Situ Sensors (http://onlinelibrary.wiley.com/doi/10.1002/2017WR020644/full) in the journal *Water Resources Research*.

This material is based upon work supported by the NH Agricultural Experiment Station, through joint funding of the National Institute of Food and Agriculture, U.S. Department of Agriculture, under award number 0225006, and the state of New Hampshire. This research also was supported by a grant from the National Science Foundation Established Program to Stimulate Competitive Research (NH EPSCoR grant #EPS-1101245) and the Town of Durham/UNH facilities, who were interested in improved estimates of nonpoint nutrient fluxes. Partial funding was provided by the National Sea Grant College Program of the U.S. Department of Commerce’s National Oceanic and Atmospheric Administration grant NA10OAR4170082 to the NH Sea Grant College Program.

Founded in 1887, the NH Agricultural Experiment Station (http://colsa.unh.edu/nhaes) at the UNH College of Life Sciences and Agriculture (https://colsa.unh.edu/) is UNH’s original research center and an elemental component of New Hampshire's land-grant university heritage and mission.

The University of New Hampshire is a flagship research university that inspires innovation and transforms lives in our state, nation and world. More than 16,000 students from all 50 states and 71 countries engage with an award-winning faculty in top ranked programs in business, engineering, law, health and human services, liberal arts and the sciences across more than 200 programs of study. UNH’s research portfolio includes partnerships with NASA, NOAA, NSF and NIH, receiving more than $100 million in competitive external funding every year to further explore and define the frontiers of land, sea and space.

Editor's Notes:

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(https://colsa.unh.edu/nhaes/sites/colsa.unh.edu.nhaes/files/media/images/oysterriver.jpeg)
NH Agricultural Experiment Station researchers studied part of the Oyster River watershed system -- the river network -- to see how much nitrogen it removed. They used a new generation of high-technology sensors placed directly into streams and rivers to measure nitrate concentrations continuously under different flow conditions.

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